Using the Learning Designer to develop a conceptual framework for linking learning design tools and systems

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This paper outlines a pedagogical rationale for a new range of analytic features within learning platforms such as LAMS and Moodle, based on the Learning Designer tool. The new tool could bring new elements into contemporary learning platforms, such as the pedagogical approach, type of thinking engaged, and the optimal allocation of learner and teacher time. The opportunity to express learning designs in these terms would encourage teacher-designers to focus on the pedagogically pertinent aspects of their learning designs and increase the level of analytic support available to them. The approach proposes a common conceptual framework for learning design, complementing the common technical specification pioneered by IMS LD, and would enable a different type of interoperability between learning platforms.

Keywords: LDSE, Learning Designer, LAMS, Moodle, learning design, analysis, teacher development, interoperability

Introduction

The quality of university teaching is becoming more regulated through bodies such as the Tertiary Education Quality and Standards Agency in Australia and the Quality Assurance Agency for Higher Education in the UK. As a consequence, universities are requiring academic staff to account for their course designs in greater detail: for example, in terms of the number of learning hours required of students and through the constructive alignment (Biggs, 2003) of learning outcomes, learning tasks and assessment. More and more, course outlines must adopt a standardised format that articulates outcomes, expectations and standards to the students. Thus, lecturers are increasingly required to think more critically about their teaching work, and to develop their 'learning design thinking' alongside the competing pressures of research and administrative tasks. Unsurprisingly, they often cite lack of time for researching their teaching and looking for learning designs created by others that may meet their needs – or, indeed, for participating in professional development initiatives to enhance their learning design capabilities. Even though one of the most effective and efficient ways to improve learning design may be to embed professional learning with the natural and ongoing process of teaching, it can be difficult to interface efficiently with other academics to this end (Goodyear & Yang, 2009).

Given the additional expectations for lecturers to adopt more technology-enhanced learning (TEL), digital technology would seem an obvious candidate for supporting lecturers' design thinking, whether as part of their everyday work or within professional development initiatives (Masterman & Manton, 2011). However, while there are a number of tools for instantiating learning designs – for example, the LAMS learning design system and Learning Management Systems (LMSs) such as Moodle, Blackboard and Sakai – they do not require the teacher-designer to consider pedagogically important aspects of the

learning design process, such as the types of cognitive processes that are engaged, the extent of interaction with others and the time costs associated with the learning design for students and teachers.

Moreover, even when lecturers venture beyond such learning platforms and locate resources and designs using a general-purpose search engine, the elements of pedagogy (if any) embedded in those resources are often not explicit, making it difficult to search for activities that support particular learning and teaching approaches (Masterman & Wild, 2011). Once these resources have been found, therefore, the teacher needs to spend time interpreting, *inter alia*, the nature of the learning that they encourage and how much time the associated activities might take. However, an additional problem arises: resources found in this way may not be easy to edit or adapt, in part because the underlying pedagogical structure may be obscured by content that is not relevant to the lecturer's context.

To address the twin problems of supporting learning design thinking and making the pedagogic structure of a learning design explicit, we have developed a software application, the Learning Designer, as part of the Learning Design Support Environment project (LDSE: http://www.ldse.org.uk). The Learning Designer provides teachers and educational designers with an interactive modelling environment for representing the pedagogically pertinent components of their learning design and providing analytic feedback so that they can better understand the implications of their designs, particularly in relation to their use of TEL. It has recently been evaluated to demonstrate proof of concept and to confirm the value to lecturers of such a system (Laurillard et al, in press).

Since evidence suggests that the process of working with multiple learning design tools can enable teachers to refine their learning design thinking (Bower & Wittmann, 2009), an emergent strand of our work is addressing the question of interoperability between the Learning Designer and learning platforms that support the instantiation of learning designs. Interoperability is a perennial technological issue for the learning design community, and attempts to foster the use of standards such as SCORM and IMS LD have enabled a limited degree of sharing across systems. However, when designs are shared via these standards the pedagogy remains largely implicit, rather than clearly articulated (Laurillard & Ljubojevic, 2011). This means that teachers may not appreciate the subtleties of the learning activities, how to implement them effectively, and – perhaps more importantly – they may miss out on an opportunity to deepen their pedagogical thinking. Moreover, the absence of pedagogical information can mean that attempts to migrate learning designs from one system to another (whether using human or technological means) cannot take into account the pedagogical intentions of the learning design and, thus, may result in translations that distort the original design intentions.

With this background in mind, the current paper has two objectives. Firstly, it gives a brief overview of the Learning Designer and the kinds of analytic support it offers teachers. Secondly, it proposes new analytic features for learning platforms in general, which can be implemented i) by embedding a Learning Designer layer within existing learning platforms, and ii) by making them interoperable through mapping the concepts in one system or tool to another and *vice versa*. The paper explores the notion of interoperability further by identifying the relations among learning activities and tools in the Learning Designer and two common learning platforms: LAMS and Moodle. It concludes by discussing the benefits and implications of the proposed functionality.

The Learning Designer

The Learning Designer is a software application supported by an intelligent inferencing engine that assists teachers in designing learning experiences for their students. The teacher-designer inputs information about the types of 'teaching and learning activities' (TLAs) that they wish to incorporate into a learning 'session' and how long learners are expected to spend on each one. This nomenclature relating to how 'sessions' (such as lectures) may involve 'TLAs' (such as group practical activities) has been devised by the team to disambiguate the various levels of analysis, and the terminology itself has been evaluated in workshops. Each TLA has two sets of predefined properties that the user can edit:

- Nature of the learning experience: personalised (i.e., unique to each student), social (e.g., a small group activity), or one-size-fits-all (e.g. a lecture).

- Proportions of different forms of learning (cognitive activities) that the TLA supports: acquisition, inquiry, discussion, practice, and production (justification and explication of categories to be provided in Laurillard, forthcoming).

This information both enables teachers to map out their learning designs and allows the Learning Designer to generate visualisations of the learning designs that teachers can use to analyse their approach.

For example, as part of a larger module of work on environmental sustainability, a learning session might aim to lead students through a critical investigation into the use of energy and water resources by their school. The session could be represented in five phases which are shown in Table 1, together with the corresponding Learning Designer TLAs and cognitive activities.

Table 1. Teaching and Learning Activities for a Session on Environmental Sustainability

Session phase	Learning Designer TLA	Duration (mins.)	Acquisition	Discussion	Inquiry	Practice	Production
i) Initial briefing	Tutor Presentation	10	100%				
ii) Planning data collection in groups	Online Tutor Guided Group Discussion (synchronous)	20		70%			30%
iii) Collecting data	Group Practical Activity	30			50%	50%	
iv) Analysing data, presenting findings	Online student group production (synchronous)	30		30%	20%	20%	30%
v) Reflecting on the school's use of resources	Online student only group discussion (asynchronous)	30		70%			30%

The teacher designs such a session by dragging TLAs from a palette on the right hand side of the screen (see Figure 1). For each activity, she or he can adjust default settings according to factors such as teaching approach and class size. She or he can also specify activity details such as duration and group size (for small-group activities), and write general notes about what the students will do. The session is automatically represented on the Learning Designer's timeline, as shown in Figure 1.

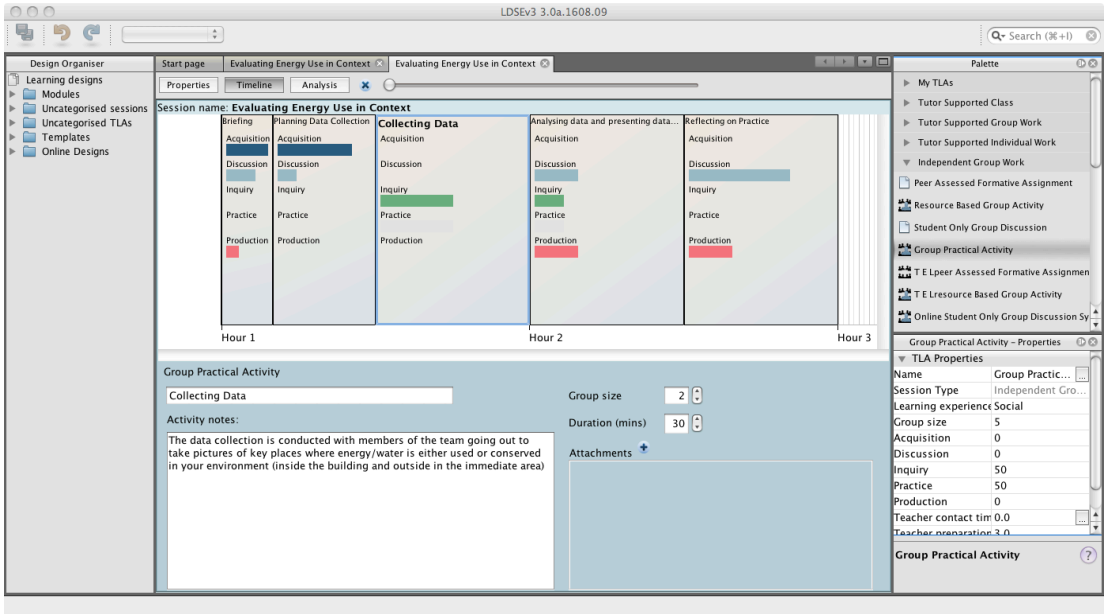

Figure 1: Representing activities within the Learning Designer

Because the teacher-designer specifies the duration of each TLA, Learning Designer can analyse how much time students will be engaged in the different forms of learning (i.e. acquisition, discussion, inquiry, practice and production), as shown in Figure 2. The teacher can then review this analysis, make adjustments to the learning design, and reflect upon the likely pedagogical impact of any changes.

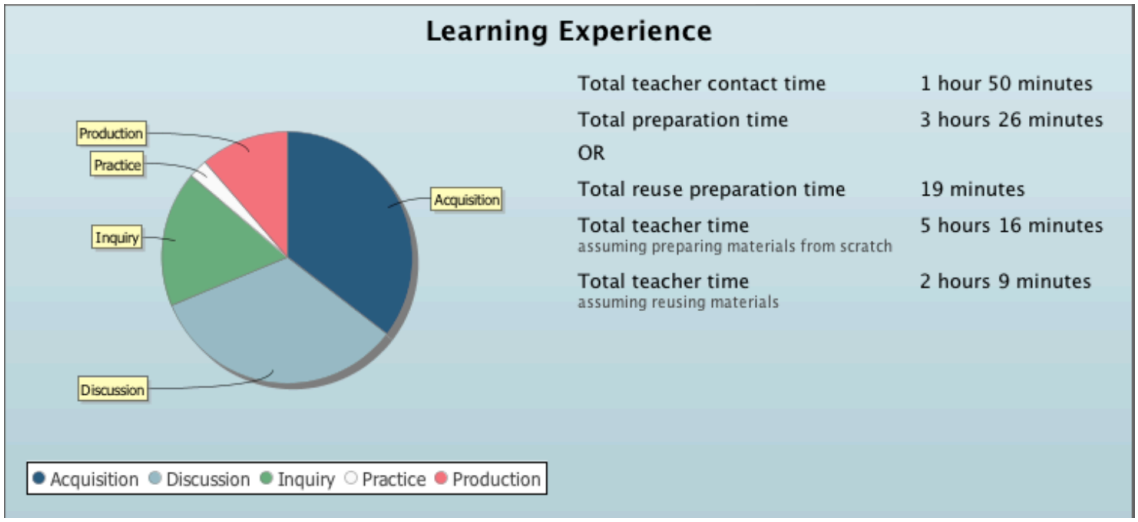

Figure 2: Customised analysis of learning design provided by the Learning Designer

The Learning Designer also incorporates an intelligent engine that can query a library of learning designs and research literature relating to the learning design that the teacher is creating. It can retrieve relevant templates and approaches, and offer ideas on alternative designs that specifically relate to the user's context. The tool is also linked to an extensive online help system that provides users with a glossary of pedagogical concepts and support for selecting learning tools. Thus, at the same time as providing teachers with a 'constructionist' (Papert & Harel, 1991) platform for creating and reflecting upon their learning designs, the Learning Designer provides context-sensitive and focused support to enhance the their understanding and effectiveness.

Embedding a Learning Designer layer within other learning platforms

The first aspect of supporting learning design thinking that we propose is to embed a Learning Designer *layer* in learning platforms such as LAMS, Moodle and Blackboard. Enabling users to provide pedagogically pertinent information about their activities within these systems should stimulate their pedagogical thinking and, in addition, allow their learning designs subsequently to be exported into the Learning Designer for analysis and sharing (as will be discussed in the next section).

From the technological perspective, this undertaking should be comparatively straightforward. The settings within each system tool would need to be modified so that users can specify the type of teaching and learning activity, the duration of the activity and the proportions of the five forms of learning that the activity supports. This information would then be stored as part of the underlying data structure for the learning designs. Figure 3 shows how the LAMS interface could be modified to enable users to specify pedagogical details and types of thinking, in this example for a forum tool. Figure 4 shows an equivalent modification that allows designers to specify this information in a Moodle forum.

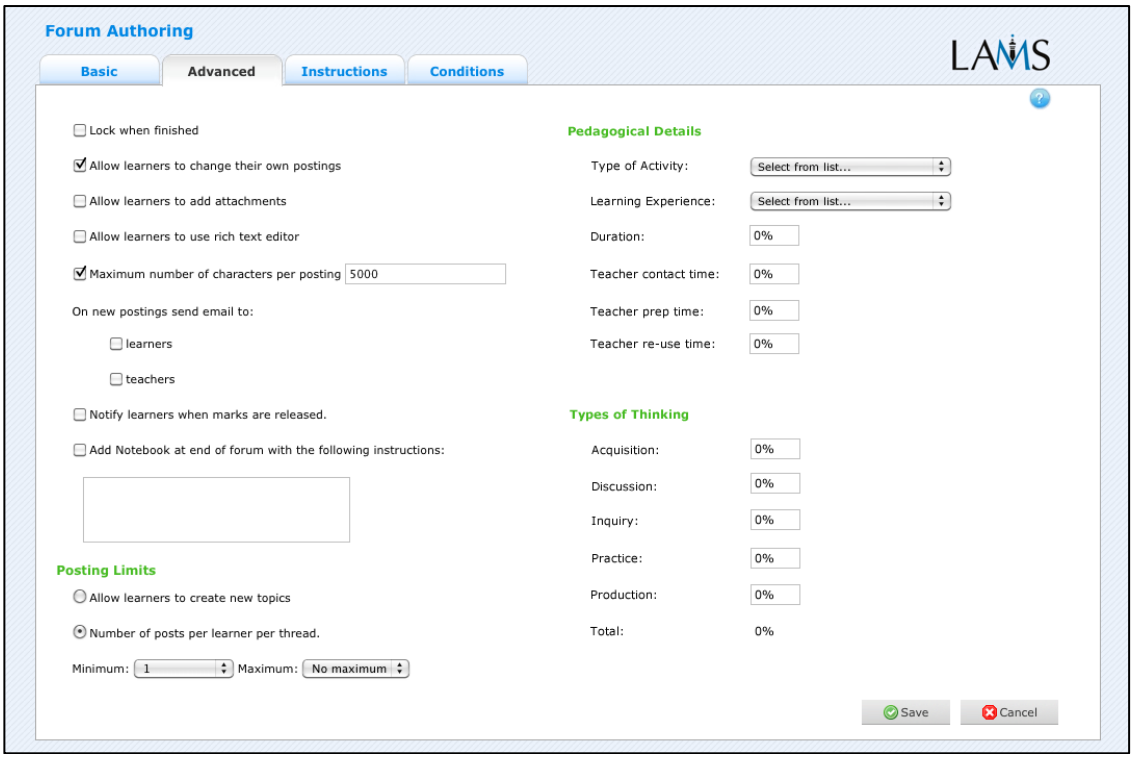

Figure 3: A LAMS tool interface modified to incorporate Learning Designer elements

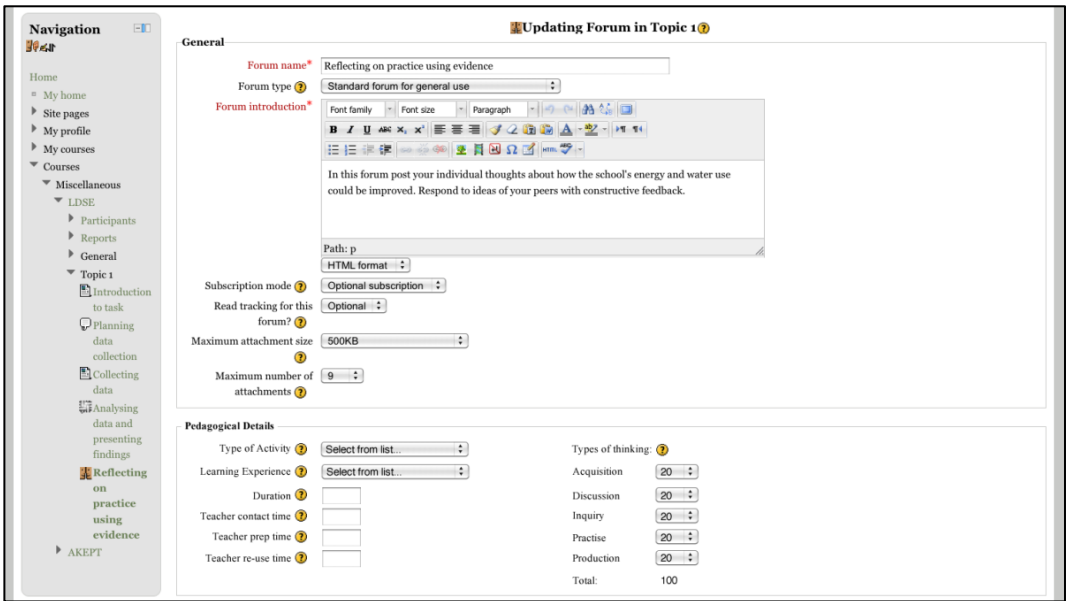

Figure 4: A Moodle tool interface adjusted to incorporate Learning Designer elements

Interoperability between the Learning Designer and other learning platforms

To address the second aspect outlined in the Introduction we are exploring interoperability between the Learning Designer and two common learning platforms: LAMS and Moodle. The interoperation will be bidirectional, such that learning designs created in the Learning Designer can be exported to LAMS and Moodle, and LAMS and Moodle designs can be exported to the Learning Designer. In the absence of any additional information from the user, the mapping between the systems will necessarily be based on a set of underlying assumptions regarding which tools in LAMS and Moodle will support TLAs defined in the Learning Designer, and which Learning Designer TLAs are to represent activities supported by tools from the other systems. Table 2 maps a representative selection of Learning Designer TLAs to their possible equivalents in LAMS and Moodle. A full mapping of all of the Learning Designer TLAs to LAMS and Moodle can be found on the LDSE project website at http://bit.ly/rtzRrF.

Table 2. Example mappings of Learning Designer TLAs to LAMS and Moodle tools

Learning Designer TLA	**LAMS tools**	**Moodle tools**
Tutor-supported class = Classes		
Online presentation by tutor (synchronous)	Web-conferencing*, Virtual World*	Web-conferencing*, Virtual World*
Online presentation by student(s) (synchronous)	Web-conferencing*, Virtual World*	Web-conferencing*, Virtual World*
Online tutor-guided class discussion (synchronous)	Chat, Chat & Scribe	Chat
Online presentation by tutor (asynchronous)	Noticeboard, Share Resources, *Task List*	*Page*, *Lesson*, *File*, *Label*, *URL*
Online tutor-guided class discussion (asynchronous)	*Forum, Forum and Scribe*, Video Recorder	*Forum*
TEL formative activity	*Voting*, *Q&A*, *Survey*, *Mindmap*, Pixlr, Noticeboard	*Choice*, *Survey*
Tutor-supported group = Tutor group		
Online tutor-guided group discussion (synchronous)	*Chat*, *Chat & Scribe*	*Chat*
Online tutor-guided group discussion (asynchronous)	Forum, Forum and Scribe, Video Recorder	Forum
Tutor-supported individual work = Tuition		
Online individual tuition	Web-conferencing*, Virtual World*, Skype*	Web-conferencing*, Virtual World*, Skype*
Independent group work = Student group activity		
TEL peer-assessed formative assignment	Wiki, Share Resources, Forum	Wiki, Folder, Forum
TEL resource-based group activity	Share Resources, Wiki, Image Gallery, Resources & Forum, Pixlr, Spreadsheet, Data Collection	Wiki, Folder, Database, Glossary
Online student-only group discussion (synchronous)	Chat, Chat & Scribe	Chat
Online student-only group discussion (asynchronous)	Forum, Forum and Scribe, Video Recorder	Forum
Online student group production (asynchronous)	Wiki, Share Resources	Wiki, Folder, Glossary
Adaptive TEL group activity	Share Resources, Resources & Forum, Spreadsheet, Gmap, Noticeboard	IMS Content Package, SCORM Package
Independent individual work = Self-directed study		
TEL resource-based individual activity	*Share Resources*, Submit Files, *Image Gallery*, Pixlr, Spreadsheet, Data Collection	File, Advanced Uploading of Files

Learning Designer TLA	**LAMS tools**	**Moodle tools**
Adaptive TEL individual activity	Share Resources, Resources & Forum, Spreadsheet, *Gmap*, Noticeboard	IMS Content Package, SCORM Package
TEL-based formative assignment	Submit Files, Q&A, Multiple Choice, *Pixlr* Mindmap, Spreadsheet, GMap, Notebook	*Advanced Uploading of Files*, Quiz
Summative Assessment		
Essay	Submit Files	*Upload a Single File*, Online Text
Exam	Assessment, Submit Files, Multiple Choice	Quiz, Upload a Single File, *Online Text*
Project Report	*Submit Files*	Upload a Single File, Online Text
Performance/Design	Submit Files	Upload a Single File, *Offline Activity*
Dissertation	Submit Files	Upload a Single File, Online Text
TEL-based summative assessment	*Assessment*	*Quiz*, Upload a Single File, Online Text

* Denotes third party tools that may be integrated via a web link (see below).

Activities are grouped in Table 2 according to session type: a classification that defines the size of the student cohort and whether or not the teacher is directly facilitating their learning. The first tool in each of the 'LAMS' and 'Moodle' columns is the suggested default tool that would be used when mapping from the Learning Designer to that system.Default mappings from tools within LAMS and Moodle to Learning Designer TLAs are shown in Table 2 in italics; each tool is mapped exactly once to a Learning Designer TLA. For example the italicised word 'Quiz' in the final cell of Table 2 indicates that under the default mapping a Moodle Quiz would be exported to a TEL-based summative assessment TLA in the Learning Designer.

Table 2 constitutes a provisional framework for mapping, not an authoritative specification. For instance, different tools can have different nuances depending upon how the task is constructed and the context in which they are being used. As well, tools often have embedded functionality that can be used creatively to redefine the pedagogical purpose of the tool. Thus Table 2 is not an exhaustive collection of mappings between tools and learning activities, just a propositional baseline set.

Learning Designer TLAs that do not involve TEL do not appear in Table 2, but could be included in LAMS and Moodle using the 'instruction' tools: viz. the Noticeboard in LAMS and Page in Moodle. Moreover, where a learning design system lacks the required functionality to support a particular TLA type (e.g. an online synchronous presentation), a link can be provided to a third-party tool (such as web-conferencing). Finally, although the assessment TLAs are not specified as TEL activities in the Learning Designer, they are included in Table 2 to demonstrate how the learning platforms can facilitate assessment.

The technical conversion between the platforms can be achieved through an XML translation of the underlying data structures of the systems involved, using the mapping outlined in Table 2. On the basis of this mapping, the learning session on environmental sustainability shown in Table 1 and Figure 1 could be exported to a LAMS sequence (as shown in Figure 5) or a Moodle module (Figure 6).

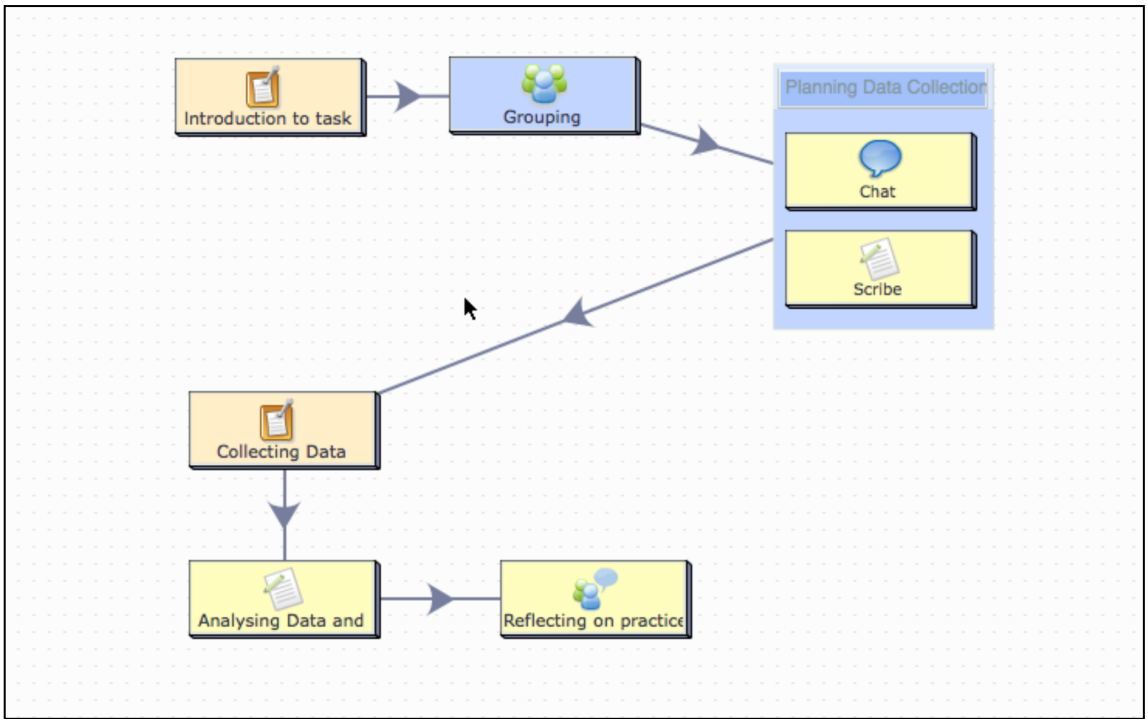

Figure 5: The Learning Designer environmental sustainability session, hypothetically exported to LAMS.

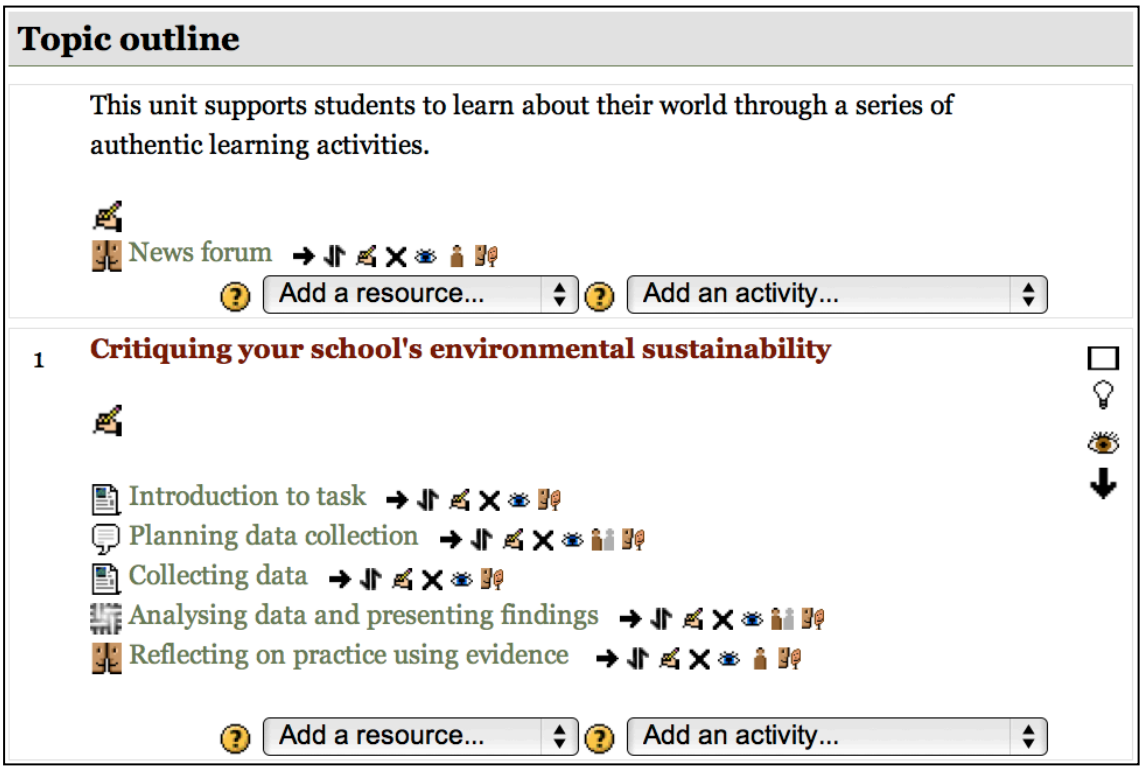

Figure 6: The Learning Designer environmental sustainability session, hypothetically exported to Moodle.

Benefits of linking the Learning Designer with other learning platforms

Like the Learning Designer, but in a more runnable form, LAMS and Moodle provide formal representations of learning designs that can be analysed as part of the teachers' ongoing education about learning design processes, thereby creating an ideal context for situated, authentic learning on the part of the teacher. A Learning Designer layer within learning platforms such as LAMS and Moodle would, we contend, not only encourage educators to think about the pedagogically pertinent features of the activities that they are designing, but would also enable more accurate mapping into the Learning Designer for analytic purposes and potential export to a third system.

The process of transferring between the Learning Designer and learning platforms such as LAMS and Moodle in itself has the potential to develop teacher-designers' pedagogical thinking. Exporting from learning platforms such as LAMS or Moodle to the Learning Designer may help the teacher-designer to become aware of the underlying pedagogical assumptions they are making in their designs through the use of the Learning Designer analytic support. Working in the opposite direction, moving a design from the Learning Designer to LAMS or Moodle requires teacher-designers to consider which online tools will best support their pre-identified pedagogical aim. Converting from the Learning Designer to a runnable instantiation in a platform such as LAMS or Moodle also demands that teacher-designers refine the more general pedagogical intent of their Learning Designer sessions into a more elaborated and concrete form that can be used by students, thus fostering more detailed and in-depth pedagogical thinking.

The point of exporting learning designs between the Learning Designer and other learning platforms such as LAMS and Moodle represents an opportunity to provide users with situated and context specific pedagogical support. For example, when exporting a design to the target system the Learning Designer could report on the assumptions that have been made (i.e. the default selection mappings), as well as the alternative tools that the user could select, depending on their needs. For instance, if the LAMS forum tool has been selected to instantiate the Learning Designer TLA 'Online tutor guided class discussion (asynchronous)', alternatives such as the 'Video Recorder' tool could also be suggested. This report would thereby foster the design thinking of teachers who were unsure of the digital tools appropriate to a particular learning activity. Another possibility would be to make the export process an interactive one, through a dialogue allowing the user to choose how to map a particular Learning Designer TLA to its equivalent tools in LAMS or Moodle, and *vice versa*. Context sensitive examples and explanations could be drawn from the Learning Designer library and glossary using the intelligent engine, further supporting the development of users' learning design capabilities.

Another potential benefit of analysing a learning design from LAMS or Moodle in the Learning Designer lies in the separation of form from content into a *learning design pattern*. Representing the design as a pattern focuses on the pedagogical elements as opposed to the topic-specific resources. This should enable the teacher-designer to pay more attention to, for example, the degree of alignment between their learning outcomes, learning activities and assessments. This constructive alignment is a fundamental and critical part of the learning design process (Biggs, 2003) and data from our earlier empirical work suggests that computational support for constructive alignment should be a core feature of the Learning Designer (Laurillard et al., in press).

Separating form from content additionally helps to balance the need for structure and free expression, which has also been shown to be an essential characteristic of a tool such as the Learning Designer (Masterman & Manton, 2011). The material that is shared via the Learning Designer layer relates to the structure of the learning design, leaving users free to express the content in any way they desire. Once a pattern has been downloaded the structure can be readily adapted within the learning design tool being used. Moreover, the fact that the Learning Designer engine stores patterns, but not necessarily all of the underlying content, may alleviate issues relating to IPR, particularly in relation to open educational resources (Masterman & Wild, 2011).

One of the central tenets of the LDSE project is 'building on the work of others': adapting, or otherwise drawing inspiration from, learning designs and patterns created by other teachers – and, thereby, extending one's own thinking. However, all too often these designs are inaccessible through being stored in other learning platforms or they lack the essential pedagogic information that would enable the hopeful re-user to make a rapid, informed decision regarding its usefulness for their purposes (Masterman &

Wild, 2011). Storing designs in a Learning Designer repository would potentially address both of these problems. The additional pedagogic information stored with the learning design would help teachers to understand the context for which the design had been created. When confident of its usefulness, they could use the export features to translate the pedagogical skeleton from the Learning Designer into their platform of choice. Moreover, the intelligent engine that underpins the Learning Designer compiles its own knowledge of a particular user's needs and preferences and thus, over time, will be able to retrieve learning designs that more accurately reflect those requirements.

The ability to export from one learning platform to the Learning Designer, and thence to a further learning platform will allow the Learning Designer to form a bridge between systems. The advantage of, say, migrating a course created in Moodle into LAMS via the Learning Designer is that the mapping would be based upon the pedagogically pertinent elements of the learning designs. This will create a degree of interoperability not yet seen in the learning design field. Moreover, combining learning designs that have been created in a variety of tools would provide the Learning Designer with a larger corpus of designs upon which users could draw and with which the intelligent engine could refine its search-matching algorithms.

Finally, the information captured by the Learning Designer can be easily exported to customisable templates: for instance, course approval forms or module outlines. Importing designs created in other systems would enable institutions to generate such documents largely automatically, saving duplication of effort.

Conclusion and future work

In summary, linking the Learning Designer with other learning platforms would offer a what we might call a 'techno-pedagogical framework' for designing, analysing and sharing learning designs across applications that can support teachers in applying quality learning and teaching principles such as those outlined by David (2009). Individual and social learning processes and outcomes are supported by providing teachers with an analysis of the extent to which their designs are 'individualised', 'social', or 'one-size-fits-all'. The active engagement of the student as learner is encouraged by reflecting to the teacher the extent to which their learning designs involve differing proportions of acquisition, inquiry, discussion, practice and production. The alignment of outcomes, assessment and learning is supported by offering a visualisation of the relationships between these elements of the design.

Even though interoperability between the Learning Designer and other learning platforms is at a very early stage of development, the concept has generated a range of possibilities. For example, the export mappings might eventually be based upon the proportions of cognitive activities that users define for each TLA. In this way, if a user defines a synchronous group discussion task with a higher proportion of production than the default proportion for that TLA, and then exports the design to LAMS, then the Learning Designer might select the Chat & Scribe tool instead of Chat. Through mapping tools and systems to each other the community can move towards greater commonality, with each tool enhancing the development of others. For example, the need to export LAMS sequences that include branching to the Learning Designer will expedite enhancement of the latter tool to allow users to define multiple paths through a learning design.

Working towards a conceptual framework for interoperable learning design can also be used as a platform for research into teachers' practice. For instance, does using the Learning Designer in conjunction with learning platforms such as LAMS and Moodle enable them to create more effective learning designs (assessed in terms of learning outcomes)? How does using the Learning Designer with LAMS and Moodle support teachers to abstract learning design concepts and principles? These and other research questions could further our understanding of learning design in a number of directions.

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